Anyone who overclocks the CPU of a PC lives in constant fear of having the processor fail due to overheating. A permanently-installed temperature monitor can do a lot to ease this fear.

Design by Dipl-Ing K. Viernickel

CPU thermometer

overclocking without overheating

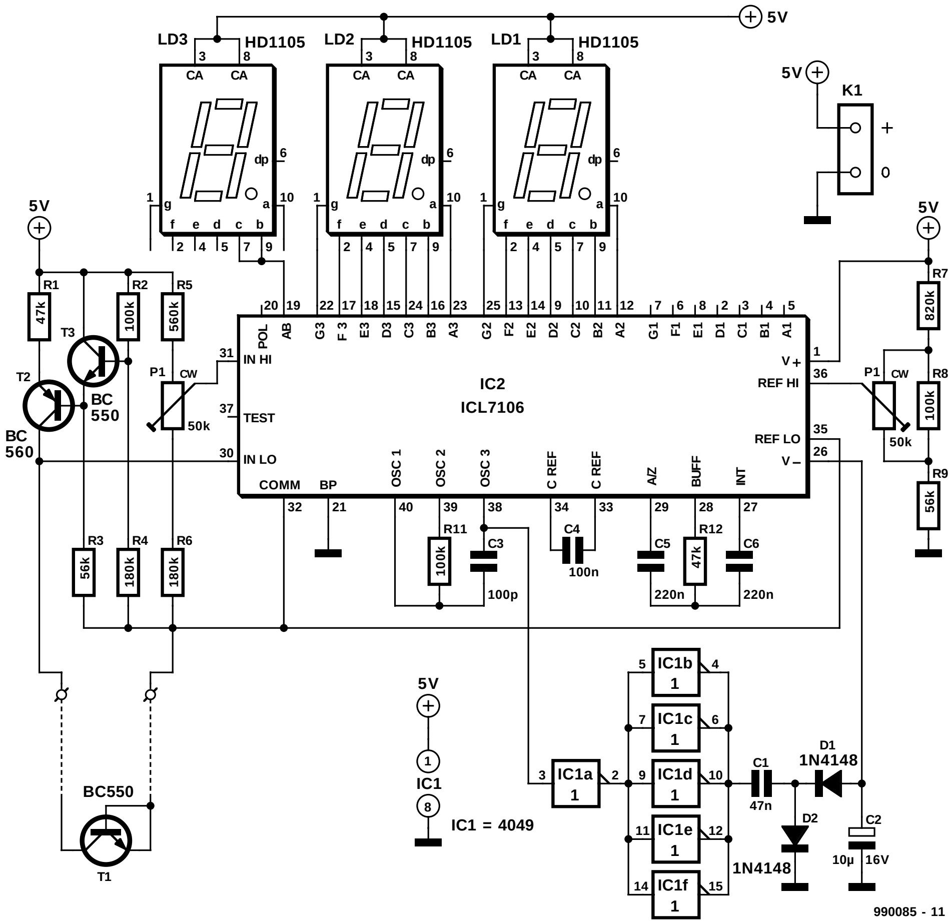

Figure 1. Schematic diagram of the CPU thermometer, showing the DVM IC and the sensor transistor T1.

If you want to coax a bit more speed out of a PC that's starting to show its age, you can try running the CPU and/or the peripheral components at a clock rate higher than that chosen by the manufacturer. This does not require soldering in a new crystal, but simply changing the positions of a few jumpers on the motherboard (typically arranged in two groups). One set of jumpers selects the system clock rate (50, 55, 60 MHz and so on, for example), which applies to the entire chip set. The other set selects a multiplier (such as 1.5, 2, 2.5 and 3). The CPU clock rate is determined by the product of the system clock rate and the multiplier. The PCI bus can also benefit from such measures, since it operates at half the system clock rate. Since the various components of the chip set, and PCI devices, are only suited to certain clock rates, you should try to keep the system clock rate 'acceptably' low and the multiplier as high as possible. For a description of how overclocking works and what you should bear in mind, see the article 'CPU overclocking' in the October 1997 issue of *Elektor Electronics*.

Better safe than sorry

A disadvantage of overclocking is that it increases the power dissipation of the CPU, which results in the generation of more heat. In order to maintain stable system operation, additional cooling of the CPU is not just recommended, but actually mandatory. If you go too far with overclocking, you risk thermal failure of the CPU, either immediately or in the (near) future. To avoid this, it is a good idea to monitor the temperature of the CPU IC. This is the task of the circuit described here. It works with a standard digital voltmeter IC (type ICL7107CPL), which can be found in any well-stocked electronics shop. The temperature sensor is the base-emitter junction of a transistor fitted in the CPU socket (Socket 7), directly underneath the processor IC. The schematic diagram in **Figure 1** shows that this transistor is connected between the IN LO and REF LO inputs of the DVM IC. It provides a voltage drop that is inversely proportional to the junction temperature.

The ICL7107CPL needs a supplementary negative supply voltage for proper operation. This is provided by the combination of D1, D2, C1 and C2. The a.c. signal that this voltage doubler requires as an input is tapped off from the internal clock oscillator of the ICL7107 and buffered by IC1.

Now we come to the main attraction of the circuit. The DVM IC can directly drive an LED display, but it is not necessary to fit a new display into the computer. Instead, you can use the two- or three-digit clock frequency display, which is already present and which in most cases is totally useless. Remove and discard the existing connections to this display, and replace them with those shown in the schematic diagram. Before you do this, check that the LED display is the common-anode type. If it is not, you will have to replace the DVM IC with the pin-compatible version 7106CPL.

Two-point calibration

Before fitting the sensor transistor underneath the CPU IC, you must calibrate the circuit. Two trimpots are provided for setting the upper and lower calibration values. You can do without a calibrated thermometer by using ice water and boiling water as references. Wrap the transistor in plastic foil to prevent it from getting wet, and immerse it first in the ice water (0 ºC). Adjust P1 so that the display indicates this value. Then perform the same adjustment with boiling water (100°C) and P2. Once the display is properly calibrated, you can fit the sensor transistor underneath the CPU IC. When the PC is operating with overclocking, the measured CPU temperature should not exceed a value of around 70 °C.

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